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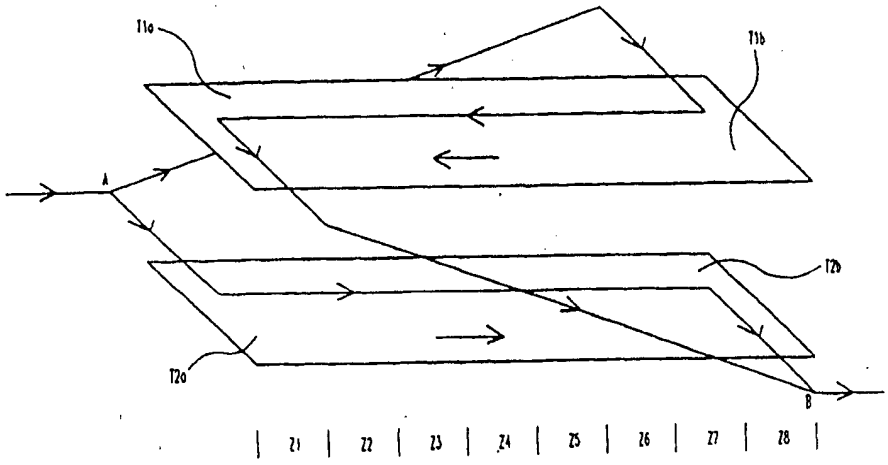

(57) Abstract

The object of the method and the apparatus according to the invention is to reduce pumping effect as well as thermal energy during regeneration of heat between the individual zones (Z1, Z2, ..., Zn) in a tunnel pasteurizer, respectively to simplify the apparatus to the extent possible. This is accomplished in an apparatus of the kind, which makes use of at least a pair of conveyors (T1, T2), in that the pair of conveyors (T1, T2) are of equal length and extend in opposite directions, and that the water, which is sprinkled down over the products in a given zone of the cooling area (Z1 to Z3) of one conveyor (T1), continues sprinkling over the products which pass through the zone of the heating area (Z1-Z3) positioned adjacent to and at the same distance and the same direction from the center of the pasteurization area (Z4, Z5) of the other conveyor (T2). The products are heated respectively cooled by water which is sprinkled over the products and is recirculated, and the regeneration of heat is accomplished by a cross exchange crosswise of the apparatus by placing the two conveyors (T1, T2) one (T1) above the other (T2) and by having the water sprinkle down directly from the top conveyor (T1) to the bottom conveyor (T2).

* (Referred to in PCT Gazette No. 22/1996, Section II)

METHOD AND APPARATUS FOR THE PASTEURIZATION OF A CONTINUOUS LINE OF PRODUCTS

The invention relates to a method for the pasteurization of a continuous line of products in an apparatus having a heating area, a pasteurization area and a cooling area, as well as means of conveyance for carrying the products through the areas in the order indicated in a regular progressing motion from the inlet of the apparatus to the outlet hereof, whereby heating, pasteurization and cooling are effected by heat transfer between the products and a fluid, preferably water, which is sprinkled over the products, the areas being divided into zones extending in the direction of motion of the products, and the temperature of the water in the individual zone being adapted according to the progress of heat transfer desired in the zone.

The invention also relates to an apparatus for use in the implementation of the said method, said apparatus having a a heating area, a pasteurization area and a cooling area, as well as means of conveyance for carrying the products through the areas in the order indicated in a regular progressing motion from the inlet of the apparatus to the outlet hereof, whereby heating, pasteurization and cooling are effected by heat transfer between the products and a fluid, preferably water, which is sprinkled over the products, the areas being divided into zones extending in the direction of motion of the products, and the temperature of the water in the individual zone being adapted according to the progress of the heat transfer desired in the zone.

In the production of products which are perishable by bacterial flora it is well-known art to destroy the bacterial flora by pasteurization, which in the case of a continuous line of products is carried out in a so-called tunnel pasteurizer.

A continuous line of products, which must necessarily be pasteurized in order to achieve keeping qualities, is known for example from the brewery industry in the form of beer or similar products, which are contained in glass bottles, cans or similar containers.

Tunnel pasteurizers are known for example from DK Patent Specification No. 161.618, US Patent Specification No. 4.490.401, GB Printed Specification No. 2.182.542 and EP Patent Specification No. 0.437.499.

In the known tunnel pasteurizers the products are pasteurized in a regular progressing movement from an inlet to an outlet. During this movement the products are heated gradually, whereby the pasteurization is accomplished, and normally a gradual cooling down will take place in the end in order to stop the pasteurization process. The apparatuses can therefore be divided into a heating area, a pasteurization area and a cooling area in the said order.

An increase in the capacity of an installation within a given floor area is often accomplished by introducing at least one additional conveyor, to the effect that the apparatus hereafter comprises a pair of conveyors, whereby the overall structural length of the tunnel pasteurizer is maintained within limits in consideration of other apparatuses ahead of and behind the tunnel pasteurizer. The two conveyors of the pair are normally installed one above the other. However, they may also be installed next to one another.

The reason why known tunnel pasteurizers comprise a heating and a cooling area is that a gradual heating and a gradual cooling is effected in order to avoid breakage of the

containers of the products, these being normally glass bottles, at abrupt changes of temperature, and thereby at the same time a heat exchange between the heating and the cooling areas is utilized for regeneration of heat energy.

The heat transfer for contained products is normally carried out by spraying the containers with a heated fluid, preferably water, as the products are carried forward through the apparatus on a conveyor, the sprinkling water passing through the conveyor. In such instances, bottom vessels are provided underneath the conveyor, and from there the sprinkling water can be pumped up to a higher level to the effect that sprinkling can continue.

The three areas mentioned are divided into individual zones, in which the temperature of the heating area is increasing from the first zone to the next, the temperature in the last zone of the heating area being sufficiently high for the products to be carried into the pasteurization area. Pasteurization is accomplished in this area by means of an additional heating, in which the temperature of the sprinkling fluid is higher than the highest temperature of pasteurization permitted for the products (so-called over-heating).

The temperature of the sprinkling water in the individual zone is adapted carefully according to the products, the lengths of the zones in the apparatus and the speed of the conveyor belt in order to ensure that the products receive the prescribed degree of pasteurization.

In the known apparatuses the water is heated by means of heat which is supplied to each of the zones, in which the products are to be heated.

In order to save energy for the operation of the apparatus,

a cross exchange of water between heating zones and the cooling zones is carried out, said zones being positioned symmetrically about the pasteurization area, as seen in relation to the longitudinal direction of the apparatus. The sprinkling water, which in a given zone of the cooling area has been heated during sprinkling of warm products in order to cool down these products, is thus directed to a zone of the heating area which is located correspondingly in relation to the pasteurization area of the apparatus to the effect that the heat of the water can be utilized for heating cold products. In a similar manner the sprinkling water which has been cooled down in a given zone of the heating area during sprinkling of cold products in order to heat these products, are directed to a zone which is located symmetrically in relation to the pasteurization area of the apparatus, to the effect that the cold water can be utilized to cool warm products.

However, a considerable amount of energy is consumed in order to pump the sprinkling water to and fro in the longitudinal direction of the apparatus, and the redistribution of water also results in a loss of heat. Mechanically the system requires the installation of heavy and complex pipe layouts.

It is therefore an object of the present invention to provide a method of saving additional energy during the regeneration of heat between the individual areas, as well as to simplify the apparatus to the extent possible.

This object is achieved by a method of the kind described in the introduction, which makes use of at least a pair of conveyors are applied, which method according to the invention is advantageous in that the pair of conveyors are of equal length and extend in opposite directions, and in that the water, which is sprinkled over the products in a

given zone of the cooling area of one of the conveyors, continues sprinkling over the products, which pass through the zone of the heating area positioned adjacent to and at the same distance and the same direction from the center of the pasteurization area of the other conveyor.

In this context, adjacent zones refer to zones which are positioned next to each other or opposite each other, as seen crosswise from the conveyors.

At each end of a tunnel pasteurizer in the method according to the invention, there are cold products on one conveyor and warm products on the other conveyor, to the effect that the heat exchange between cold products and warm products can be accomplished simply by directing the sprinkling water from one conveyor to the other.

By means of this method it is ensured that the regeneration of heat is effected without lengthwise pumping, and that the construction of the apparatus becomes simplified since the different zones of the heating and cooling areas for the two conveyors can be designed having equal lengths symmetrically about the center of the apparatus.

The invention also relates to an apparatus for use in the implementation of the method in question and being of the kind described in the introduction, which is provided with at least a pair of conveyors, which apparatus according to the invention is advantageous in that the pair of conveyors are of equal length and extend in opposite directions, and in that the apparatus has means to direct water, which is sprinkled over the products in a given zone of the cooling area of one conveyor, further on over the products, which pass through the zone of the heating area positioned adjacent to and at the same distance and the same direction from the center of the pasteurization area of the other

conveyor.

The independent claims relate to preferred embodiments, respectively preferred apparatuses for use in the implementation of the method, the advantages of the contents of the independent claims being described below.

The method according to the invention will be explained in detail below on the basis of a tunnel pasteurizer having two conveyors placed one above the other, said conveyors being of the type which is used for example in the brewery industry for the pasteurization of products for the purpose of increasing the shelf life hereof, the apparatus forming part of a bottling unit, for example for the production of beer or similar products in glass bottles, cans or similar containers, and with reference to the drawing, in which

Fig. 1 is a schematic illustration of the contained products being fed to two conveyors in a tunnel pasteurizer according to the invention;

Fig. 2 is a schematic illustration of the progress of the temperature in a continuous line of contained products, which are carried forward at their respective conveyors in the apparatus according to the invention.

In a tunnel pasteurizer of known type, which is provided with two conveyors having the same length, one conveyor is positioned above the other. The top conveyor will be referred to as T1 and the bottom conveyor as T2. A line of products is fed to the two conveyors of the apparatus.

According to the invention the two conveyors T1, T2 move in opposite directions through the apparatus, as indicated by

the arrows in Fig. 1. At one point A which is located ahead of the first end of the apparatus, the line of products is divided into two lines, whereupon the first line is fed directly into the bottom conveyor T2 at the first end T2a hereof and through the apparatus to the opposite other end T2b of the conveyor.

At the end T2b the line leaves the conveyor T2 and continues to a point B.

The second line, however, is directed to the opposite other end of the apparatus and is directed to the end T1b of the top conveyor T1. From here this line is directed through the apparatus towards the end T1a at the said first end of the apparatus.

At the end T1a the line leaves the conveyor T1 and is directed to the point B, where the line joins the line advancing from the bottom conveyor T2 for the formation of one single line, which is then carried further on to a subsequent apparatus of the bottling unit.

As indicated in Fig. 2, the apparatus is divided into zones, which are referred to successively, for example from the first end of the apparatus as Z1, Z2,...,Z8. It will be obvious that the number of zones in the apparatus as required may be considerably higher than the eight zones illustrated.

The zones Z4 and Z5 together constitute a pasteurization area, in which the sprinkling water has a temperature corresponding to the temperature necessary in order to pasterurize the products. Thus the method according to the invention does not involve the so-called overheating but the pasteurization area is designed to be of a length, which is sufficient to provide the temperature of

pasteurization in the products.

Each zone is provided with a vessel containing water, which can be sprinkled down over the products on the conveyor T1 and T2 by means of a pump.

The water in the individual zones has a temperature, which depends on the distance of the individual zone from the center of the apparatus constituting the pasteurization area in the form of the zones Z4 and Z5 and so that the temperature in a zone is always lower than the temperature in a zone, which is located closer to the pasteurization area.

With regard to the zones Z1 and Z8, it will appear from Fig. 2 that the temperature of the products on the line of the bottom conveyor T2 is increasing along the zones Z1 to Z5, reaching a maximum value at the transition from zone Z5 to zone Z6, whereupon the temperature again decreases in the zones Z6 to Z8.

This is due to the fact that the zones Z4 and Z5 as explained above are supplied with warm water having a temperature which corresponds to the temperature of pasteurization, the warm water being sprinkled down over the products on the bottom conveyor T2.

The temperature of the water in zone Z6, however, is lower than the temperature in the zones Z4 and Z5, as will be explained below, as a result of which the products will be cooled down somewhat. A similar situation will apply in the subsequent zones Z7 and Z8.

It will appear from the the temperature chart curve for the first conveyor T1 in fig. 2 that the temperature of the products on the line increases through the zones Z8 to

Z4, reaching a maximum value at the transition from zone Z4 to Z3, whereupon the temperature again decreases in the zones Z3 and Z1.

The water in zone Z6 has been sprinkled over the products, which at the same time are carried forward in the opposite direction on the top conveyor T1, where the products are colder than the products on the bottom conveyor T2. The sprinkling water in zone Z6 has thus during a heat exchange between the products on the two conveyors become cooled upon joining the colder products on the top conveyor T1.

A similar situation will apply for the zones Z7 and Z8, where the warmer products on the bottom conveyor T2 are sprinkled with water, which was also been sprinkled over the cold products on the top conveyor T1.

The increased temperature for the products on the bottom conveyor T2 in the zones Z1 to Z3 is correspondingly the result of the sprinkling water in these zones having been sprinkled over the warm products on the top conveyor T1.

The source of heat, which heats the water in the zones Z4 and Z4 as well as the remaining zones in the event of an imbalance is preferably a central source of heat.

The term imbalance will here refer to a condition during operation when the progression of temperature in one or more zones for some reason does not progress as planned, as a result of which warm or cold water must be supplied to the products in question.

The pasteurization described up to now takes place when a stable exchange of heat has set in after the operational temperature has been reached in the tunnel pasteurizer

according to the invention. Until this condition has been reached, it is necessary to terminate this imbalance by adding heat or cold.

The regenerative condition is achieved in the prior art apparatuses only when the apparatuses are always filled. Conveyors which are not filled uniformly will correspond to having a gap in a traditional apparatus, and such interruption of production must be countered by adding additional heat and cooling water. Such interruption of production in an apparatus according to the invention is obviated by controlling the conveyors.

The method, in which the conveyors move in opposite directions with two conveyors, will require a new design for the feeding conveyors, which in some cases may appear to be a complication and in other cases to be a simplification, depending upon the layout of the lines of the external conveyors.

The advantages of the method according to the invention are especially the following:

a) A perfect regeneration of heat since the exchange of energy is carried out as directly as possible,

b) a perfect balance in the amount of water for the regenerative zones, since each set of zones work as an independent unit,

c) the possibility of reducing the amount of water in the connected zones,

d) simplification of design for the mechanical construction of the apparatus and resulting less maintenance,

e) lower consumption of energy, since the water circulates only crosswise between zones and not lengthwise along the apparatus, and

f) the possibility of providing more regenerative zones without increasing the complexity of pipe layouts and with resulting increased regeneration.

In the apparatus according to the invention total symmetry has been provided in all aspects:

1) The lengths of opposite zones - i.e. zones which are placed symmetrically in relation to the pasteurization area - must be of equal length in order to ensure equal treatment of the products on both conveyors,

2) heating - all of the zones need or will need warm water supply at the start of the apparatus, however this is not a complication, since with a central source of heat this involves only an extra on/off water connection to the regenerative zones, which have not been supplied already.

3) the temperatures of the zones - since the treatment of the products takes place in both directions through the apparatus, the application of overheating of the products is not possible. This requires an extension of the pasteurization area but improves the quality of the products at the same time, since none of the pasteurized products are exposed to temperatures, which exceed the temperature of pasteurization.

4) control strategy - since the products are carried forward and treated in opposite directions, interference in the event of abnormal production also becomes

symmetrical - i.e. "backwards cooling" is not possible. This is a limitation in the patterns of interference, however, only a limitation in comparison with the most sofisticated forms of interference in the event of abnormal production in tunnel pasteurizers.

PATENT CLAIMS

1. Method for the pasteurization of a continuous line of products in an apparatus having a heating area, a pasteurization area and a cooling area as well as means of conveyance for carrying the products through the areas in the order indicated in a regular progressing motion from the inlet of the apparatus to the outlet hereof, whereby heating, pasteurization and cooling are effected by heat transfer between the products and a fluid, preferably water, which is sprinkled over the products, the areas being divided into zones (Z1 to Z8) extending in the direction of motion of the products, and the temperature of the water in the individual zone being adapted according to the progress of heat transfer desired in the zone, and wherein a least a pair of conveyors (T1, T2) are applied, **characterized in** that the pair of conveyors (T1, T2) are of equal length and extend in opposite directions, and in that the water, which is sprinkled over the products in a given zone of the cooling area (Z1 - Z3) of one conveyor (T1), continues sprinkling over the products, which pass through the zone of the heating area (Z1 - Z3) positioned adjacent to and at the same distance and the same direction from the center of the pasteurization area (Z4, Z5) of the other conveyor (T2).

2. Method according to claim 1, **characterized in** that the two conveyors (T1, T2) are preferably positioned one (T1) above the other (T2).

3. Apparatus for use in the implementation of the said method, said apparatus having a heating area, a pasteurization area and a cooling area as well as means of conveyance for carrying the products through the areas in the order indicated in a regular progressing motion from

the inlet of the apparatus to the outlet hereof, whereby heating, pasteurization and cooling are effected by heat transfer between the products and a fluid, preferably water, which is sprinkled over the products, the areas being divided into zones (Z1-Z8) extending in the direction of motion of the products, and the temperature of the water in the individual zone being adapted according to the progress of heat transfer desired in the zone, and wherein the apparatus has at least a pair of conveyors (T1, T2), **characterized in** that the pair of the conveyors (T1, T2) are of equal length and extend in opposite directions, and in that the apparatus has means to direct water, which is sprinkled down over the products in a given zone of the cooling area (Z1-Z3) in one conveyor (T1), further on over the products, which pass through the zone of the heating area (Z1 to Z3) positioned adjacent to and at the same distance and the same direction from the center of the pasteurization area (Z4-Z5) of the other conveyor (T2).

4. Apparatus according to claim 3, **characterized in** that the two conveyors (T1, T2) are placed one (T1) above the other (T2).

5. Apparatus according to claim 3, **characterized in** that the apparatus is preferably provided with a central source of heat for heat supply to the pasteurization area (Z4,Z5).

6. Apparatus according to claim 5, **characterized in** that the central source of heat is adapted to maintain the water in the pasteurization area at a temperature which corresponds to the temperature sufficient for pasteurization of a predetermined product.

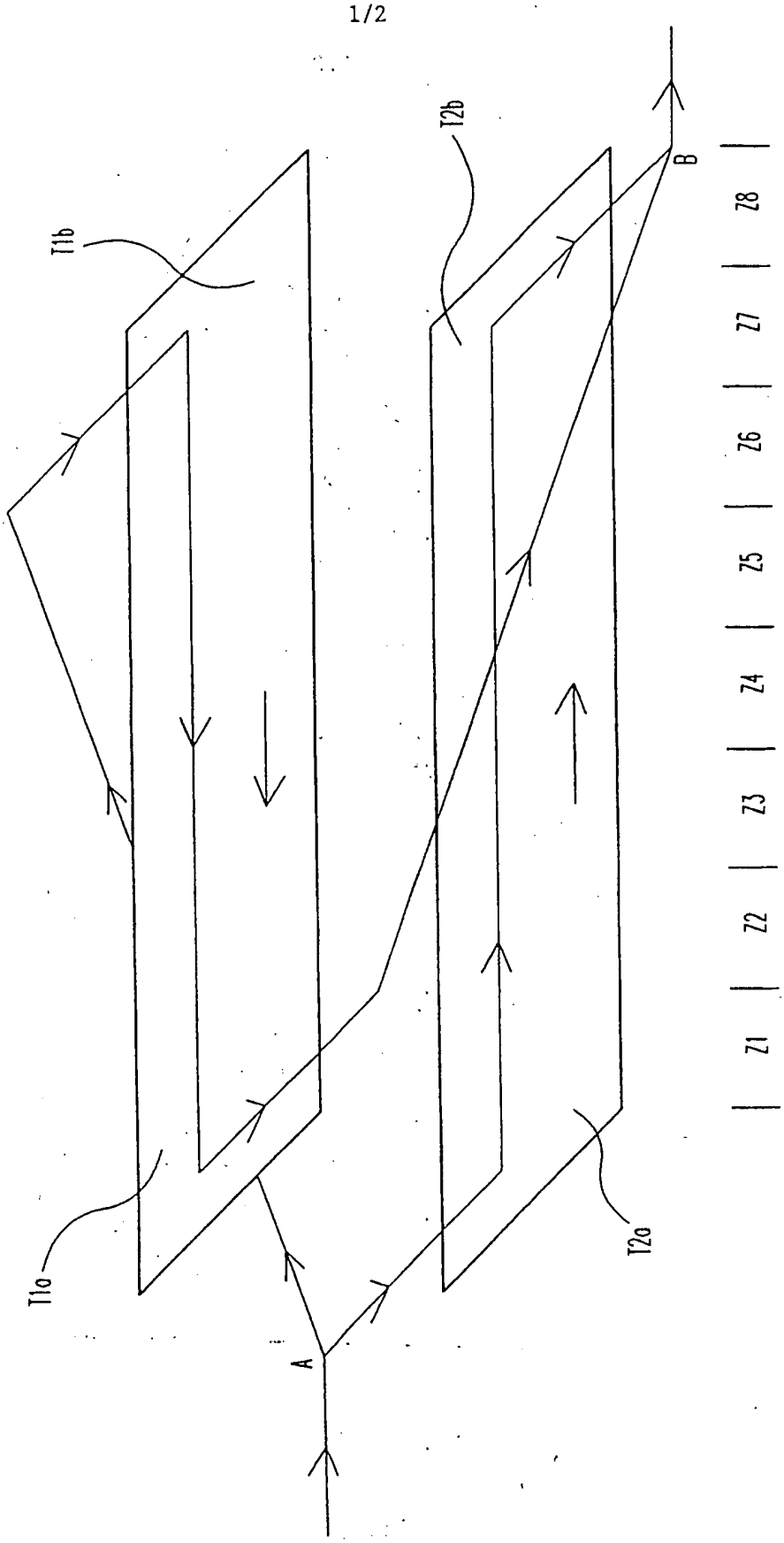

Fig. 1

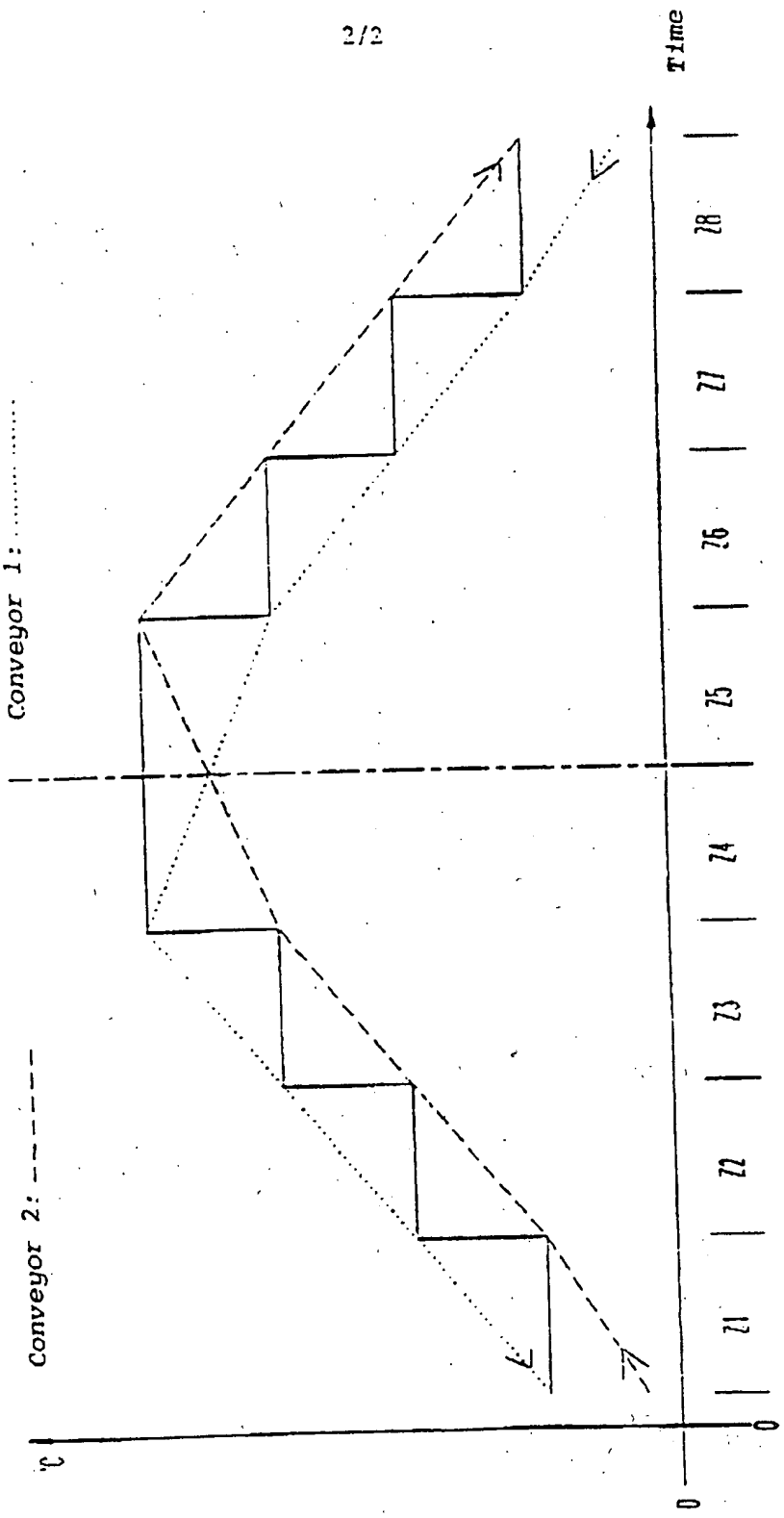

Fig. 2